INVESTIGATION USING DATA FROM ERTS TO DEVELOP AND IMPLEMENT UTILIZATION OF LIVING MARINE RESOURCES

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June 1973
Interim Report for Period July 1, 1972 to March 10, 1973
Combined Type I and Type II

Principal Investigator: William H. Stevenson
Project Number: 240
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Prepared for
GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland 20771

6.0 SIGNIFICANT RESULTS

Significant results derived under the terms of this project are best noted in the paper by A. J. Kemmerer and J. A. Benigno (Section 5.0, Item 5). However, for purposes of this report the abstract and the tentative conclusions of the authors are presented.

ABSTRACT

A feasibility study to demonstrate the potential of satellites for providing fisheries significant information was conducted in the Mississippi Sound and adjacent offshore waters. Attempts were made to relate satellite acquired imagery to selected oceanographic parameters and then to relate these parameters to aircraft remotely sensed distribution patterns of resident surface schooling fishes. Initial results suggest that this approach is valid and that the satellite acquired imagery may have important fisheries resource assessment implications.

TENTATIVE CONCLUSIONS

1. The distribution of photographically detected adult menhaden in the Mississippi Sound was significantly correlated with secchi disc visibility, surface salinity, water color, and water depth.

2. ERTS-1, 7 August, channel 5 imagery appeared to contain fishery significant information; all detected menhaden schools were located in areas of lowest image density.

3. Image density patterns could be explained statistically with good precision based on water depth and secchi disc visibility measurements, parameters which correlated significantly with the distribution of menhaden.

7.0 DATA BANK AND PROCESSING OPERATIONS

All of the field data, with the exception of the aircraft and satellite imagery, has been entered in our computer banks. The system has been debugged and is operating and responding to queries and manipulations satisfactorily. New routines have been formulated and these are available in addition to those stated in the project plan. The ENVIR Information Management System of the Gulf Universities Research Consortium has been successfully integrated into our own data management system.

Twenty-nine processing and software development requests have been completed through the Slidell Computer Facility. Turn-around time has been satisfactory to date. However, we anticipate that the increased load to the Slidell Facility, due to Skylab requests from other sources, will increase future turn-around time per our requests.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

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15. Supplementary Notes

This report is a combination Type II/Type I effort requirement for the period under Item 13. It has been retitled as an "Interim Report".

16. Abstract The primary objective of this experiment is to demonstrate the feasibility of using satellite imagery to determine the availability and distribution of adult Gulf menhaden B. patronus within the Mississippi Sound and adjacent waters. Secondary objectives are: 1) determine the effectiveness and reliability of ERTS and aircraft remote sensing data to provide fisheries-significant coastal oceanographic information, and 2) ascertain the usefulness of these and other resource data for improving resource harvesting and management. Selected oceanographic, meteorological, and biological parameters are being used as indirect indicators of the resource. Synoptic sea-truth, fishery sampling and weather data, as well as photo and thermal IR imagery, have been acquired as data inputs, and a computer program has been developed to manipulate these data according to user requirements. The experiment is producing correlations between satellite, aircraft, fisheries, and environmental sea-truth data. The resulting information is being used to minimize the effort needed for resource distribution studies, and also provide new areas of investigation for remote sensing.

17. Key Words (Selected by Author(s))	18. Distribution Statement
ERTS-1, Remote Sensing, Fisheries, Menhaden, Mississippi Sound, Imagery Analysis, Aerial Photography Low-light-level Image Intensifier.	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
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Figure 2. Technical Report Standard Title Page

Preface

The primary objective of this experiment is to demonstrate the feasibility of using satellite imagery to determine the availability and distribution of adult Gulf menhaden B. patronus within the Mississippi Sound and adjacent waters. Secondary objectives are: 1) determine the effectiveness and reliability of ERTS and aircraft remote sensing data to provide fisheries-significant coastal oceanographic information, and 2) ascertain the usefulness of these and other resource data for improving resource harvesting and management. Selected oceanographic, meteorological, and biological parameters are being used as indirect indicators of the resource. Synoptic sea-truth, fishery sampling and weather data, as well as photo and thermal IR imagery, have been acquired as data inputs, and a computer program has been developed to manipulate these data according to user requirements. The experiment is producing correlations between satellite, aircraft, fisheries, and environmental sea-truth data. The resulting information is being used to facilitate development of minimum levels of effort required to obtain data for resource distribution studies, and is providing insight into areas of investigation applicable to remote sensing as a tool for resource assessment and monitoring.

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List of Abbreviations and Symbols

B&W	Black and White
CANC	Cancelled
CED	Coincident ERTS Pass on Ops Date
COMP	Completed
E-18	Aircraft, Beechcraft, ERL/MTF
EARTHSAT	Earth Satellite Corporation
ERL	Earth Resources Laboratory (NASA)
E-PASS	ERTS Pass over Test Site
FEL	Fisheries Engineering Laboratory (NMFS)
GSFC	Goddard Space Flight Center
ID	Identification
IN	Inch
IR	Infrared
JSC	Johnson Space Center
KM	Kilometer
LLLII	Low-light-level Image Intensifier
MINI	Shakedown Mission
MM	Millimeter
MSS	Multispectral Scanner
MTF	Mississippi Test Facility
NCB	Aircraft, NC130B, NASA/JSC
NFMOA	National Fish Meal and Oil Association
NS	Not Scheduled
OPS	Operations
P3A	Aircraft, NP3A, NASA/JSC
PASC	Pascagoula (NMFS)
P-COMP	Partially Completed
PI	Principal Investigator
PRIMARY	Primary Mission
RS	Remote Sensing
SAD	Scheduled Aircraft Down
SCHED	Schedule
SECONDARY	Secondary Mission
SPOT	Spotter Aircraft, Fishing
SVF	Surface Vessel, Fishing
SVO	Surface Vessel, Oceanographic
TA	Terminated Activity
+TRANSP	Positive Transparency

1.0 INTRODUCTION

This progress report is the third in a series under NASA/ERTS-1 Project No. 240, GSFC I.D. CO 321. This accounting is to be considered as an Interim Report, combining information normally ascribed within the required Type I and Type II report, covering the period July 1, 1972 to March 10, 1973. Type I reports were previously submitted on September 20 and November 5, 1972.

The primary objective of this experiment is to demonstrate the feasibility of using satellite imagery to determine the availability and distribution of the adult Gulf menhaden B. patronus within the Mississippi Sound and adjacent waters. Secondary objectives are: 1) determine the effectiveness and reliability of ERTS and aircraft remote sensing data to provide fisheries-significant coastal oceanographic information, and 2) ascertain the usefulness of these and other resource data for improving resource harvesting and management. Selected oceanographic meteorological, and biological parameters are being used as indirect indicators of the resource.

The study is being conducted through implementation of four sub-experiments categorized as Utilization, Living Marine Resources, Oceanographic, and Aerospace. Synoptic sea-truth, fishery sampling and weather data, as well as photo and thermal IR imagery, have been acquired as data inputs, and a computer program has been developed to manipulate these data according to user requirements.

Participants of this cooperative venture include various Federal, state and local givernment agencies, universities, and commercial groups. The experiment is producing correlations between satellite, aircraft, fisheries, and environmental sea-truth data. The resulting information is being used to facilitate development of minimum levels of effort required to obtain data for resource distribution studies, and providing insight into areas of investigation applicable to remote sensing as a tool for resource assessment and monitoring.

2.0 PROJECT PARTICIPANTS

2.1 Principal and Co-Investigative

This project is a cooperative venture whose participants originate from various federal, state, and local government agencies, universities and commerical enterprises. Parent agencies and/or groups and their respective main-line components and/or contractors who are Principal Investigative and Co-Investigative are as follows:

National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Fisheries Engineering Laboratory (FEL)
Pascagoula Laboratory

National Aeronautics and Space Administration (NASA)
Earth Resources Laboratory (ERL-MTF)

National Fish Meal and Oil Association (NFMOA)
Earth Satellite Corporation (EARTHSAT)

2.2 Associated Groups and Agencies

Various groups and agencies who have and are providing assistance in one form or another to the Principal and Co-Investigative elements within the project are as follows:

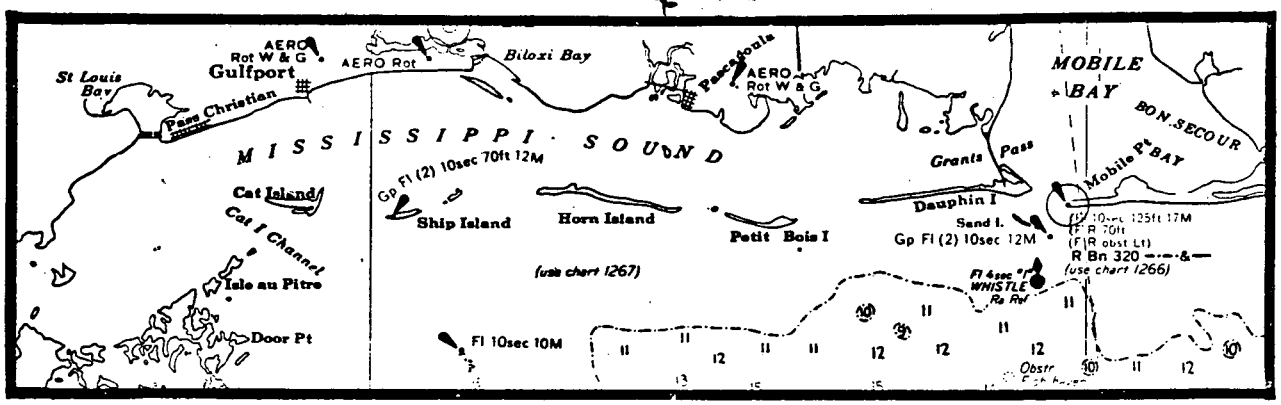
National Oceanic and Atmospheric Administration (NOAA)
- National Marine Fisheries Service (NMFS)
  - Miami Laboratory
  - Beaufort Laboratory
- National Environmental Satellite Service (NESS)
- Atlantic Oceanographic and Meteorological Laboratory (AOML)
- National Weather Service (NWS)

National Aeronautics and Space Administration (NASA)
- Johnson Space Center (JSC)
- Goddard Space Flight Center (GSFC)
- Marshall Space Flight Center (MTF)
  - Contractor Support

Alabama Department of Conservation
Gulf Coast Research Laboratory (GCRL)
Gulf Universities Research Consortium (GURC)
U.S. Corps of Engineers (Alabama)
Mississippi State University (MSU)

3.0 TEST SITE

The test site selected is the Mississippi Sound and environs (Fig. 1) bounded by coordinates 30° 27'N/89° 30'W, 30° 27'N/87° 45'W, 30° 00'N/87° 45'W, and 30° 00'N/89° 30'W. The linear dimensions are length: 170 km, width: 51 km, encompassing a total area of 8685 sq. km.



TEST SITE COORDINATES

	LATITUDE	LONGITUDE
A)	30°27'N	89°30'W
B)	30°27'N	87°45'W
C)	30°00'N	87°45'W
D)	30°00'N	89°30'W

SCALE 1:875,000

N.MI. 10 20

KM. 10 20 30 40

TEST SITE DIMENSIONS

LENGTH: 170 KM.

WIDTH: 51 KM.

AREA: 8685 SQ.KM.

Figure 1 - Project 240 Test Site

The Sound is an estuarine complex located in the northeastern part of the Gulf of Mexico, and interfaces with the oceanic waters of the Gulf proper through a chain of barrier islands situated almost parallel to the Sound. The Sound itself is approximately 17 km. wide by about 110 km. in length with an average depth of about four meters. Major brackish water embayments influencing the Sound's water characteristics are Mobile Bay to the east, Biloxi Bay just west of center to the north, and St. Louis Bay to the northwest. The Pearl and Pascagoula River systems provide an influx of fresh water to the Sound. The western part of the Sound is further influenced by the mixing of water from Lake Pontchartrain located to the northwest of the test area and interconnected via a body of shallow water referred to as Lake Borgne (unnamed in the figure) situated immediately east of Cat Island. The area immediately south of the barrier islands is characterized by near oceanic water which provides a contrast to the Sound proper.

4.0 DATA ACQUISITION OPERATIONS

Major data acquisition platforms were the ERTS-1 satellite, aircraft (both medium and low altitude) and surface vessels (both oceanographic and fishing/oceanographic). Field data acquisition operations were conducted from July 6 through November 4, 1972. Termination of these activities were due to:

a. Non-availability of schooling menhaden
b. Non-availability of fishing/oceanographic vessels as fishing data acquisition platforms based on (a)
c. The successive build-up and projected adverse weather conditions over the test site for the remainder of the year.

Table 1 identifies the schedule, status and associated information of each primary and secondary mission during the project's field data acquisition phase.

4.1 Mini-Missions

A dry-run primary mission effort was tentatively scheduled for late June or early July prior to the ERTS-1 launch in order to "shake-down" our entire field data acquisition system. After numerous delays due to weather, the mission was successfully completed on July 6 with all systems operating satisfactorily. This dress rehearsal provided the experience and operational knowledge necessary for effective acquisition of data during the satellite overpass phases as well as the non-satellite dates of data acquisition. Figure 2 depicts a typical mission schedule of activities which were carried out during the course of a primary and/or secondary mission operation.

4.2 Primary Missions

Primary missions are defined as those field operations during which all data acquisition platforms were to be available for scheduled use. Primary mission dates were intentionally selected to coincide with at least one of the two ERTS-1 passes over our test site. Table 1 identifies the schedule, status and associated information of each primary mission during the field data acquisition phase. Of the four primary missions attempted, one was completed, two were partially completed and one was cancelled due to inclement weather conditions. The term "P-COMP" (Partially Complete) in reference to mission status indicates a major malfunction and/or sporadic functioning of any field component (platform, sensor, etc.) scheduled for operation on the actual mission date. In the same sense, the term "COMP" (Complete) indicates all field components were functioning to specification.

4.3 Secondary Missions

Secondary missions are defined as those field operations during which a minimum number of data acquisition platforms are available for scheduled use. Secondary mission dates were intentionally selected to fall on Tuesday of each consecutive week during the entire field operations phase in order to provide a continuum of data for analysis between the ERTS-1 passes and primary mission dates. Table 1 identifies the schedule, status, and associated information of each secondary mission during the reporting period. Seventeen secondary missions were scheduled and one was not. Of these, fourteen were attempted, five were completed, six were partially completed, seven cancelled and seven were recycled.

4.4 Mission Efforts

A summary of mission efforts during the field data acquisition phase appears as Table 2. The term "RECYCLED" refers to postponement or advancement of a scheduled mission. For example, a scheduled Sept. 5 secondary mission (Table 1) was recycled to Sept. 6.

TABLE 1 - FIELD DATA ACQUISITION OPERATIONS FROM 6 JULY TO 4 NOVEMBER 1972

MISSION TYPE	SCHED. DATE	OPS. DATE	ERTS SCHED.		AIRCRAFT OPERATIONS					VESSELS		MISSION STATUS
			CED	E-PASS	P3A	E-18	PASC.	FEL	SPOT.	SVO	SVF	
Mini	30 Jun	6 Jul	No	NS	NCB	Yes	Yes	Yes	Yes	Yes	Yes	Comp.
Secondary	11 Jul	11 Jul	No	NS	NS	Yes	Yes	Yes	Yes	Yes	Yes	Comp.
Secondary	18 Jul	20 Jul	No	NS	NS	Yes	Yes	NS	Yes	Yes	Yes	P-Comp.
Secondary	25 Jul	25 Jul	No	NS	NS	Yes	Yes	NS	Yes	Yes	Yes	Comp.
Secondary	1 Aug	1 Aug	No	NS	NS	Yes	Yes	NS	Yes	Yes	Yes	Comp.
Primary	7 Aug	7 Aug	Yes	6-7 Aug	Yes	Yes	Yes	Yes	Yes	Yes	Yes	P-Comp.
Secondary	8 Aug	None	No	NS	7 Aug -- Primary Mission Evaluation							Canc.
Secondary	15 Aug	15 Aug	No	NS	NS	Yes	Yes	Yes	Yes	Yes	Yes	P-Comp.
Secondary	22 Aug	None	No	NS	25 Aug -- Primary Mission Preparation							Canc.
Primary	None	25 Aug	Yes	24-25 Aug	Yes	Yes	Yes	NS	Yes	Yes	Yes	Comp.
Secondary	29 Aug	None	No	NS	25 Aug -- Primary Mission Evaluation							Canc.
Secondary	5 Sep	6 Sep	No	NS	NS	Yes	Yes	Yes	Yes	Yes	Yes	Comp.
Primary	11 Sep	None	Yes	11-12 Sep	Inclement Weather - Recycle to 12 Sep							Canc.
Secondary	12 Sep	None	Yes	11-12 Sep	Inclement Weather - Recycle to 13 Sep							Canc.
Secondary	None	13 Sep	No	NS	NS	SAD	Yes	Yes	Yes	Yes	Yes	P-Comp.
Secondary	19 Sep	19 Sep	No	NS	NS	Yes	Yes	NS	Yes	Yes	Yes	Comp.
Secondary	26 Sep	None	No	NS	29 Sep -- Primary Mission Preparation							Canc.
Primary	29 Sep	28 Sep	No	29-30 Sep	Yes	Yes	Yes	NS	Yes	Yes	Yes	P-Comp.
Secondary	3 Oct	4 Oct	No	NS	NS	Yes	SAD	Yes	TA	Yes	TA	P-Comp.
Secondary	10 Oct	11 Oct	No	NS	NS	SAD	SAD	Yes	TA	Yes	TA	P-Comp.
Secondary	17 Oct	18 Oct	Yes	17-18 Oct	NS	Yes	SAD	NS	TA	Yes	TA	P-Comp.
Secondary	24 Oct	None	No	NS	Inclement Weather - Recycle to 4 Nov							Canc.
Secondary	4 Nov	None	Yes	4-5 Nov	Inclement Weather							Canc.
Future Field Data Acquisition Ops Not Scheduled												

FIGURE 2 - TYPICAL MISSION SCHEDULE

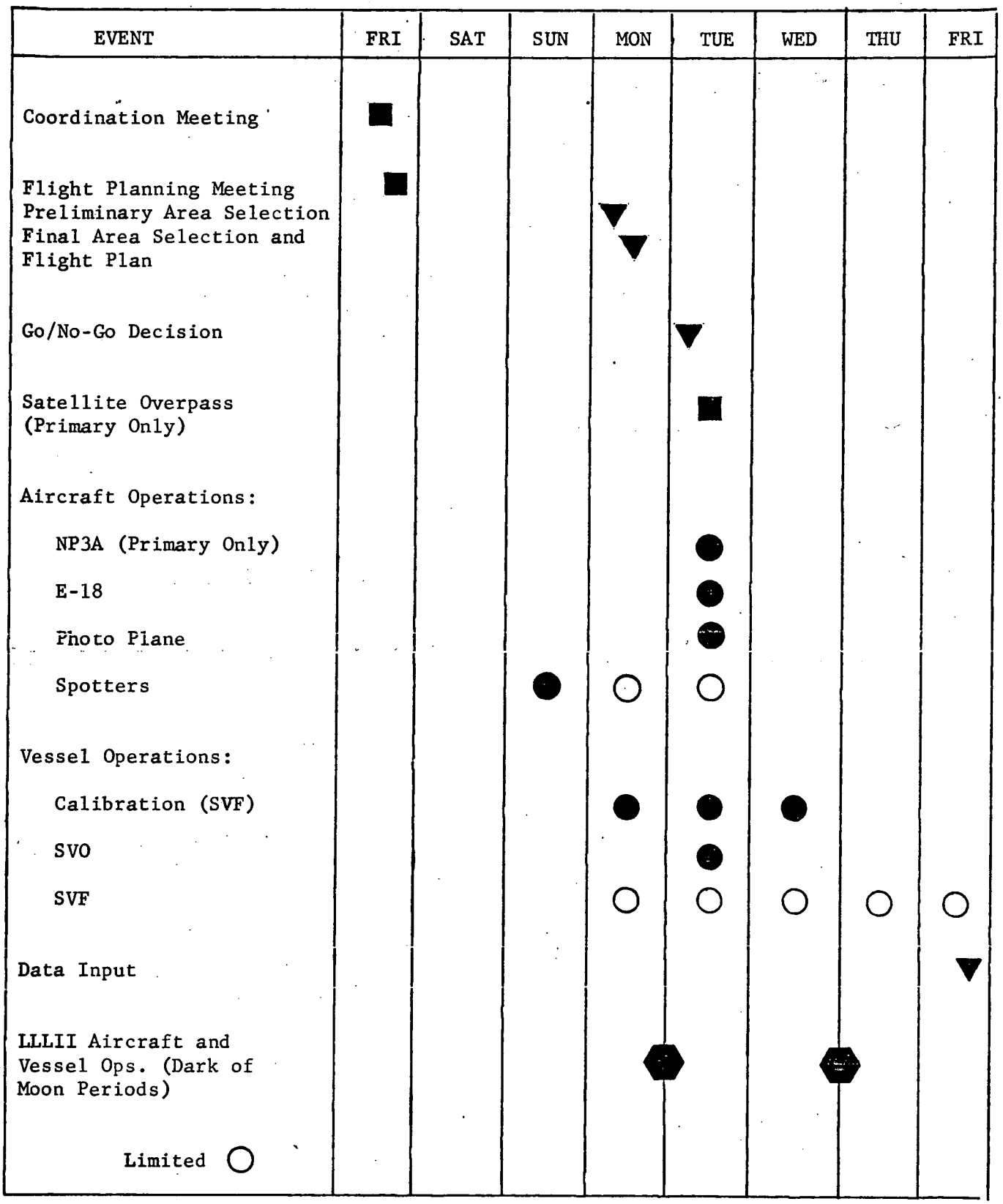


TABLE 2 - SUMMARY OF MISSION EFFORTS FROM 6 JULY TO 4 NOVEMBER 1972

MISSION STATUS AND PLATFORM USAGE	MISSION TYPE		
	Mini	Secondary	Primary
Scheduled	1	17	3
Unscheduled	0	1	1
Attempted	1	14	4
Completed	1	5	1
Partially Completed	0	6	2
Cancelled	0	7	1
Recycled	1	7	2
Coincident ERTS Pass	0	2	4
NC130B Aircraft Ops.	1	0	0
NP3A Aircraft Ops.	0	0	3
E-18 Aircraft Ops.	1	9	3
Pascagoula Aircraft Ops.	1	8	3
FEL/LLLII Aircraft Ops.	1	6	1
Fish-Spotting Aircraft Ops.	1	8	3
Oceanographic Vessel Ops.	1	11	3
Fishing Vessel Ops.	1	8	3

5.0 REPORTS GENERATED

In addition to the Type I Progress Reports, and this one, as mentioned in Section 1.0 - Introduction, a number of other reports have been generated. These reports have been either totally or partially supported under terms of Contract No. S-70246-AG. They are, in order of origination date, as follows:

1. Maughan, P. M. Investigation to Improve Menhaden Fishery and Prediction. Oct. 1972. NASA Earth Res. Surv. Prog. Wkly. Abs., 93-72-34, Nov. 1972, NASA-CR-128288, 2 p.

2. Stevenson, W. H.: Maughan, P. M. and Atwell, B. H. Application of ERTS-1 for Fishery Resource Assessment and Harvest. Oct. 1972. Presented during the 8th. Internat. Symp. RS Environ. held at the Willow Run Lab., Mich. also in: NASA Earth Res. Surv. Prog. Wkly. Abs. 93-72-38, Dec. 1972. NASA-CR-128486, 4 p.

3. Maughan, P. M. An Investigation to Improve the Menhaden Fishery Prediction and Detection Model Through The Application of ERTS-A Data. Dec. 1972. NASA Earth Res. Surv. Prog. Wkly. Abs., 93-73-07, Feb. 1973, NASA-CR-129654, 19 p.

4. Maughan, P. M. Investigation to Improve Menhaden Fishery Prediction. Feb. 1973. NASA Earth Res. Surv. Prog. Wkly. Abs., 93-73-13, Mar. 1973, NASA-CR-130374., 39 p.

5. Kemmerer, A. J. and Benigno, J. A. Relationships Between Remotely Sensed Fisheries Distribution Information and Selected Oceanographic Parameters In The Mississippi Sound. March 1973, 11 p. Presented at the ERTS-1 Symposium held during 5-9 March 1973, at GSFC, Greenbelt, Md.

6. Maughan, P. M.; Marmelstein, A. D. and Temple, R. Application of the ERTS-1 Imagery to the Harvest Model of the U.S. Menhaden Fishery. March 1973, 6 p. Presented at the ERTS-1 Symposium held during 5-9 March 1973, at GSFC, Greenbelt, Md.

In our data analysis utilizing the Computer Facility, multiple regression routines have been extensively employed to seek relationships between various environmental parameters, and between certain parameters and fish distribution as well as abundance. Statistical routines have been used to group various sets of environmental and fisheries data which were then graphically displayed utilizing an SC 4020 plotter.

Land mass plotting routines of the Mississippi Sound area have been developed and utilized to display fish school location data acquired from low-light-level television night aircraft operations, and low altitude aerial photographic missions during daylight hours.

We have developed an ordination analysis program which is being utilized to group discrete data expressing a similarity within a set of multiple parameters.

8.0 IMAGERY DATA CATALOGING SYSTEM

In order to effectively manage and control the in-house and external use of the ERTS-1 products received within the confines of our experiment activities, we have established an open-ended Imagery Data Cataloging System (IDCS). The system is based on a modification of the NDPF supplied imagery coding annotations marriaged with our own coding system. Imagery request codes and supplemental data are in a computer data bank separate from our ERTS Master Data File, and will be integrated at some future date. The IDCS is now completely operational and is being utilized by the project participants.

9.0 ERTS-1 PRODUCT STATUS

During October 1972 we updated our request for ERTS-1 products pursuant to our specific needs and submitted a revised ERTS-1 Product Order Form on October 20 to support our requirement. At present we are making full use of the 9.5 inch and 70 mm B&W imagery, especially MSS bands 4 and 5.

Our imagery request covers the period from August 6, 1972 through September 27, 1973. Table 3 lists the 9.5 inch, B&W, MSS positive transparencies we have received of our test site as of March 10, 1973.

TABLE 3 - 9.5 in. B&W MSS & Transp. Received as of 10 Mar. 73.

Acquisition Date	MSS 4	5	6	7	Acquisition Date	MSS 4	5	6	7
6 Aug. 72	●	●	●	●	5 Nov. 72	●	●	●	●
7 Aug. 72	●	●	●	●	22 Nov. 72	●	●	●	●
24 Aug. 72	●	●	●	●	11 Dec. 72		●		●
25 Aug. 72	●		●	●	28 Dec. 72	●	●	●	●
11 Sep. 72	●	●	●	●	15 Jan. 73	●	●	●	●
12 Sep. 72	●	●	●	●	16 Jan. 73	●	●	●	●
29 Sep. 72	●	●	●	●	2 Feb. 73	●	●	●	●
30 Sep. 72	●	●	●	●	3 Feb. 73	●	●	●	●
17 Oct. 72	●	●	●	●					
18 Oct. 72	●	●	●	●					

The response to our standing order for imagery from GSFC has been quite satisfactory. However, in a few instances we have received imagery of poor quality and therefore unusable. We feel that some of the below par imagery was generated as a direct result of processing errors. These items are rare, however, and the GSFC response to rectify the situation has been quite good.

In other instances we have received imagery not requested. We surmise that these images were inadvertantly included as part of our regular shipment, and in actuality, should have been forwarded to the P.I, requesting them. In this regard, it is our policy to return all imagery which has not been requested and in all cases, this type of action has been taken and recorded.

10.0 MEETINGS

Project personnel participated in or attended a number of meetings, conferences, symposiums and workshops related directly or indirectly to our ERTS-1 research efforts. Brief summations of these activities follow.

July 1972

1. The P.I, participated in an ERTS-1 public affairs news conference in Washington, D.C. Contributions included impact and anticipated impact of remote sensing on living marine resource assessment.

2. The FEL hosted an ERTS-1 Project Workshop at MTF for all project participants. Major topics discussed were finalization of our data acquisition matrix, schedule reviews, completion of the user data format matrix, and secondary mission aircraft coverage.

September 1972

1. The P.I. presented a talk entitled "Remote Sensing Applications to the Fisheries Environment" at the American Society of Mechanical Engineers Aviation and Space Conference held in Anaheim, California. Portions of his presentation dealt with our ERTS-1 project efforts.

2. The P.I. addressed members of the National Fish Meal and Oil Association (NFMOA), a group concerned with the menhaden fishery, on various aspects of our ERTS-1 project. The meeting was held in New Orleans, Louisiana.

3. Project personnel attended an ERTS User Data Meeting held at GSFC, Greenbelt, Maryland, to discuss preliminary findings as a result of our "quick-look" analysis of ERTS data.

4. The P.I. and other project personnel attended the 8th International Symposium of Remote Sensing of the Environment held at the Willow Run Laboratory, Ann Arbor, Michigan. A technical paper (Sect. 5, Item 2) was presented to the conferees.

October 1972

1. The P.I. met and conferred with a visiting Soviet Scientific Team in Miami, Florida. One topic of discussion was our ERTS-1 project efforts.

January 1973

1. The P.I. presented a program plan for NMFS participation in the Skylab/EREP Program to cognizant NASA personnel in Washington, D.C. A major discussion topic was our ERTS-1 Project efforts and the relationship of these activities to the EREP program.

February 1973

1. A co-investigative member on the project participated in an ERTS-1 Ocean Color Meeting held at GSFC, Greenbelt, Maryland. One of our inputs was recommendations for future satellite sensor systems and coverage as well as frequency of data acquisition.

2. The FEL hosted a NOAA-wide remote sensing workshop whose theme was "The Application of Aerospace Remote Sensing to Fisheries Problems". The FEL ERTS-1 project efforts and results to date were specifically addressed. The workshop was held at MTF, Bay St. Louis, Mississippi.

March 1973

1. Project personnel participated in the NASA/GSFC sponsored ERTS-1 symposium held at GSFC, Greenbelt, Maryland. Papers on ERTS-1 data analysis (Sect. 5.0, Items 5 and 6) were formally presented to attendees.

11.0 FUTURE ACTIVITIES

Future activities include continued refinement of software development for input, manipulation, and output of data under our Data Management Information System (DMIS). Now that our field operations have ceased, our primary efforts will be in updating our DMIS, and analysis of acquired data through utilization of the various routines available at the Slidell Computer Facility.

In addition, we are continuing our analysis along the lines developed by A. J. Kemmerer and J. A. Benigno. We anticipate developing a series of prediction models for menhaden availability in the Mississippi Sound as one possible result of our remote sensing research.

12.0 CONCLUSIONS

Our ERTS-1 project efforts have been very satisfactory to date. Significant results have been derived and reported. Our project objectives, primary as well as secondary, are being achieved. Our data acquisition system provided usable data of a high quality even though inclement weather and platform/sensor malfunctions tended to hamper field operations. Success of the data acquisition can be attributed, in part, to the results of the "mini-mission" and an intentional data gathering redundancy built into the system. The persistent efforts of high quality personnel both in the data acquisition phase and the current analysis phase contributed highly to our successful efforts to date.

13.0 RECOMMENDATIONS

No recommendations are provided at this time. However, a series of recommendations are being developed and will be an integral part of our final report.